

CLAIMS:

1. An electroplating system, comprising:
 - a vessel assembly for holding an electrolyte;
 - a weir thief electrode assembly in the vessel assembly, the weir thief electrode assembly including a plenum inside of a weir frame, the weir thief electrode assembly divided into at least a first virtual thief electrode segment and a second virtual thief electrode segment;
 - a plurality of spaced apart openings through the weir frame into the plenum; and
 - a weir ring attached to the weir frame.
2. The electroplating system of claim 1 with the weir frame further including an angle section extending from the weir ring towards a plane section, and the plurality of spaced apart openings in the plane section.
3. The electroplating system of claim 2 further including a cylindrical weir lip on the weir frame, the plane section perpendicular to the weir ring and the plurality of openings centered on a diameter greater than an inner diameter of the weir ring.
4. The electroplating system of claim 1 further comprising a first physical thief electrode and a second physical thief electrode in electrical continuity with the first virtual thief electrode segment and the second virtual thief electrode segment, respectively, the first and the second physical thief electrodes electrically connected respectively to a first independently controllable power supply source and a second independently controllable power supply source.
5. The electroplating system of claim 4 wherein the vessel assembly includes a vessel frame, and the first and the second physical thief electrodes are supported on the vessel frame at a vertical position below the weir ring.

6. The electroplating system of claim 4 wherein the virtual thief electrode assembly further includes a third virtual thief electrode segment and a fourth virtual thief electrode segment, a third physical thief electrode and a fourth physical thief electrode in electrical continuity with the third virtual thief electrode segment and the fourth virtual thief electrode segment,
5 respectively, the third and the fourth physical thief electrodes electrically connected respectively to a third independently controllable power supply source and a fourth independently controllable power supply source, the fourth virtual thief electrode segment subtending an angle of 1 to 15 degrees.
7. The electroplating system of claim 6 further including a first thief channel, a second
10 thief channel, a third thief channel and a fourth thief channel in the vessel assembly extending respectively from first, second, third and fourth chambers containing the first, the second, the third and the fourth physical thief electrodes to the plenum.
8. The electroplating system of claim 7 further including a thief channel membrane in each
15 thief channel, a chamber containing a second electrolyte below each thief channel membrane, the second electrolyte in each chamber in contact with one of the physical thief electrodes.
9. The electroplating system of claim 6 wherein the vessel assembly includes an electrolyte vessel below the weir thief electrode assembly and a paddle in the vessel, the paddle attached to a paddle actuator, for agitating the electrolyte.
- 20 10. The electroplating system of claim 6 wherein the first and the third virtual thief electrode segments subtend an angle of 130 to 150 degrees and the second virtual thief electrode segment subtends an angle of 70 to 90 degrees.
11. An electroplating system, comprising:
- a vessel assembly including a lower cup and an upper cup on top of the lower cup;
 - 25 a vessel membrane between the lower cup and the upper cup;
 - a paddle above the upper cup connected to a paddle actuator for moving the paddle;

a weir thief electrode assembly in the vessel assembly above the paddle, the weir thief electrode assembly including a weir frame having a plenum divided into at least a first virtual thief electrode segment, a second virtual thief electrode segment and a third virtual thief electrode segment;

5 a plurality of spaced apart openings in the weir frame to allow electrolyte to flow out of the plenum; and

a first physical thief electrode and a second physical thief electrode in electrical continuity with the first and the second virtual thief electrode segments, respectively, the first and the second physical thief electrodes electrically connected respectively to a first
10 power supply source and a second power supply source.

12. The electroplating system of claim 11 wherein the virtual thief electrode assembly further includes a third virtual thief electrode segment and a fourth virtual thief electrode segment, a third physical thief electrode and a fourth physical thief electrode in electrical continuity with the third virtual thief electrode segment and the fourth virtual thief electrode
15 segment, respectively, the third and the fourth physical thief electrodes electrically connected respectively to a third independently controllable power supply source and a fourth independently controllable power supply source, wherein the first, the second, the third and the fourth physical thief electrodes are at a vertical position below the paddle and are electrically continuous with the first, the second, the third and the fourth virtual
20 thief electrode segments via a first, a second, a third and a fourth thief channel in the vessel assembly extending respectively from the first, the second, the third and the fourth physical thief electrodes to the plenum, at least part of the first, the second, the third and the fourth thief channels filled with electrolyte.

13. The electroplating system of claim 11 wherein the paddle comprises a plurality of
25 parallel spaced apart blades and a first slot and a second slot between adjacent blades.

14. The electroplating system of claim 11 with the paddle further including chord shaped openings at opposite sides of the paddle.

15. The electroplating system of claim 12 wherein the first and the third virtual thief electrode segments subtend an angle of 130 to 150 degrees, the second virtual thief electrode segment subtends an angle of 70 to 90 degrees, and the fourth virtual thief electrode segment subtends an arc of 5 to 15 degrees.